the adjective *fungous* may have been intended, with the *o* accidentally omitted. Or could it be that the much abused word *fungoid* would have met the author's requirement? The use of words from the sciences demands caution from the general writer, but in a scientific journal there should be no lapse, certainly none from the pen of a critic. The word *fungus* with its derivatives is too often misused.

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QUOTATIONS

The American University from Two Points of View

The finest thing which civilization has yet produced is a great American university upon a private foundation. A company of gentlemen associate themselves and assume the obligation of providing the means for, and the organization of, an institution for the highest culture, not only without any pecuniary compensation to themselves, but giving freely of their time, effort and substance, and securing, in their aid, the countenance and contributions of their friends and fellow citizens, and a body of scholars, selected by this original association, who, sacrificing at the outset the prospect of worldly gain, devote themselves zealously and enthusiastically to the discovery of truth and its dissemination and to the making of character—such, in brief outline, is this great product of human evolution. No other nation on the earth has brought the like of it forth. It is the peculiar offspring of American conscience and American liberty. To have had an honorable part in the creation of such an institution is a privilege of the highest order and obligates the happy participant to render to his fellowmen an account of his experiences.—Dean John W. Burgess in the *Columbia University Quarterly* for September.

In America there are three sexes—men, women and professors. It is the saying of European scholars looking from those self-governing democracies, their universities, upon ours. They see ours ruled without the consent of the governed through presidential autocrats by boards of non-scholar trustees—not a part of the world of learning, but superimposed upon it. The American professor has the status of an employee subject to dismissal without trial by men not his colleagues.

The universities of Germany, the older universities of England and Scotland respect and trust and leave free the individual. Their organization gives them the right to regard themselves as provinces of the republic of letters. The overlorded universities of America have no such right.

For a couple of centuries American professors have submitted to a system which gives most of them little control over their own lives, small power to defend any truth which has powerful enemies, no part in shaping the policies of the institutions in which they teach. Hence the pitiable figure of the American scholar to whom Emerson, Emersonically oblivious of such little matters as despotic college government, held up a high ideal of independent manhood.

The position of her scholars under the thumb of business men and capitalists who control the university purse is enough to account for the fact that America is intellectually second rate. Unless content to remain so Americans have got to think down to bedrock about university government and do what thought demands.

Feeling that something is wrong, we have begun to examine the life of our universities, but no general attention has centered as yet upon their inherited, undemocratic system of control which is bearing the fruit of timidity and subservience among those twenty-three thousand men and five thousand women whose social function is to create and transmit American thought.—George Cram in the *Forum* for October.

SCIENTIFIC BOOKS

Determination of Time, Longitude, Latitude and Azimuth. Fifth Edition. By William Bowie. Special Publication No. 14, U. S.

Coast and Geodetic Survey. Washington, Government Printing Office. 1913.

It is the purpose of the reviewer to discuss Parts I. and II. only—the parts relating to the determination of time and longitude.

The reason for the appearance of the volume is twofold: first, the fourth edition, by Professor John F. Hayford, at the time inspector of geodetic work, has become exhausted; and secondly, so much that is new has developed in the interim, and so much of the old has become changed or entirely discarded, that it has been thought advisable, even though much of the old material may be found scattered through other publications, to issue still another volume, one which shall be in itself complete and thoroughly accordant with present practise. So great is the demand for this valuable manual that the new edition has already nearly given out, and it has consequently been found necessary to order the printing of an additional thousand copies.

The self-registering transit micrometer, introduced by Repsold a quarter century ago, and the principle soon after adopted in Europe of reversing the transit instrument during the observation of each star, have almost revolutionized the methods of longitude determinations. Their advantage is that they afford additional strides forward in the direction of eliminating constant and systematic errors by skilful observational manipulation rather than by applying corrections in the course of the computation. Reversal during the transit of each star eliminates collimation, inequality of pivots, irregularity and other errors of the transit micrometer screw (or, if a fixed reticle be employed, the thread intervals), and, in the case of the broken-back telescope, bisection error and flexure. With regard to the micrometer, though claim has been made that its use leads to a higher degree of precision, its chief value lies in that it almost annihilates the observer's personal equation. As the instrumental and personal equations are thus so greatly reduced, further approach is rendered possible towards the ideal arrangement of reducing the observational errors exclusively to the accidental type. These two innovations have accordingly been attended with so great success that, employed originally in the field, they have found their way even into the fixed observatory.

There the right-ascension micrometer has come to stay. Whether the ponderable telescopes of the fixed observatory can be adapted to quick reversal, however, remains yet to be seen. At Kiel and at Bergedorf they are employing transit circles designed and built with this purpose in view, but the onlooker during the operation of reversal instinctively fears for the safety of the instrument. Experiments are still under way. Speedy reversal with the portable transit, on the other hand, was long ago effected by both the Germans and the French, the latter developing the straight telescope with diagonal eye-piece, the former the broken back.

Ever alert as the Coast and Geodetic Survey authorities are for any device bearing the impress of improvement, they have stamped their mark of approval upon both these innovations. Though they have not purchased or made any astronomic instruments for time observations since the appearance of the fourth edition of their manual, they have recently ordered two telescopes of the broken type, reversible on each star, such as have "been used with marked success by other countries," and illustrated in Plate 2. The right-ascension micrometer they welcomed a decade back. Skilfully designed by the chief of the instrument division, Mr. E. G. Fischer, and tested in a thorough experimental and theoretical investigation by Professor Hayford,[1] the micrometer has since proved of such worth that the effect of its introduction may be traced throughout the new edition.

When the chronographic method of star registration was introduced in the middle of the last century—and it will be recalled what a prominent part the Coast Survey played in the introduction—astronomers fondly hoped to eliminate by its means that most troublesome of "constant" errors, personal equation. That it greatly reduced the magnitude of this

[1] Appendix No. 8, Report of the Superintendent for 1904, "A Test of a Transit Micrometer."

equation as obtained by the method of the eye and ear is well established. The same fond hopes lay at the basis of introducing the "impersonal" micrometer; and again there has been a great reduction in personal equation. The evidence in favor of annihilation, however, is inconclusive. Though many astronomers have succeeded in reducing the equation to practically within the limits of accidental error, and some have made so bold as to affirm that the equation has entirely disappeared, there yet remain other astronomers who have not been able to verify these conclusions—witness the experiences at Ottawa. As likely as not, history will repeat itself.

Even if personal equation has not been annihilated, nevertheless, astronomers now possess an advantage that formerly was not theirs; and that is, that with present facilities it is possible entirely to dissipate the effect of personal equation in longitude determinations. For the *variation* of personal equation, generally conceded to be the chief source of longitude error, may, now that the personal equation itself has become so much lessened, be looked upon as lessened to a corresponding degree, which makes it negligible; and the small residual amount of personal equation left in the observations by the right-ascension micrometer may be made to disappear through exchange of observers.

It is only in the finest class of longitude work that the precaution of exchanging observers is deemed necessary. For ordinary geodetic purposes, since personal equation has become so small as to be termed negligible, this precaution is believed to be needless. The introduction of the transit micrometer has consequently led to radical changes in the methods and program of survey longitude operations. "The program of longitude observations was formerly designed to eliminate the personal equation" (p. 79); and variation of personal equation is a bugbear no longer to be feared. The influence on the time and expense connected with longitude work (p. 94) may be estimated from the fact that it has been found possible, in accordance with Professor Hayford's prediction of 1904, without loss of accuracy, to reduce the original program of ten nights' observing to three or four. It should be noted, however, that even with the method of the key, "a reduction of the number of nights per station to six, or even four, would result in but slight decrease in accuracy" (p. 94).

Before leaving the topic of personal equation it may be well to call attention to another form of this equation, the bisection error. On page 90 the writer believes that for ordinary geodetic purposes this is too small to be considered. This may or may not be true; and it may make a difference whether a single or a double thread be employed. Contradictory evidence may be found in "A Test of a Transit Micrometer," above cited (p. 472), and "Report of the Chief Astronomer," Ottawa, 1909 (pp. 576 et seq.). By reversal during the transit of each star, as already mentioned, the bisection error is automatically eliminated from observations made with the broken-back telescope. With the straight telescope, this elimination may be effected, not from each individual star, but from the clock correction, by a suitable selection of stars north and south of the zenith.

Returning to the survey observing program, another innovation involves the sets of stars comprising a time determination for longitude. The former custom of requiring generally four half-sets is still retained; but the nature of the sets is greatly changed. Where formerly it was customary to observe four clock stars and one azimuth star to each half-set, the clock stars chosen with balanced A factors, the practise now is to eliminate the azimuth star entirely, and to replace it by two additional clock stars. As the interval of time required to observe each star is less than by the method of the key, the total time employed is not greater than before. The argument is, that as the azimuth of the instrument, owing to the balancing of the A factors, has but little effect upon the resulting time determination, it is preferable, rather than to attempt determining this azimuth accurately with an azimuth star, to strengthen the clock correction by observing additional time stars. For

a discussion of this topic see the fourth edition, p. 295.

At latitudes higher than 50°, where it is impracticable to obtain sufficiently slowly moving zenith stars with balanced A factors, and where, consequently, the error in azimuth will materially affect the clock correction, the older method of observing an azimuth star is still employed. The number of stars in each half-set, however, following perhaps the practise of the Germans, is increased to six. It is a fair question, in this connection, whether this ratio of azimuth to clock stars is sufficiently large.

The time sets are so chosen, and the reversals of the instrument between half-sets so planned, as to eliminate collimation and inequality of the pivots (p. 19). Inequality and irregularity of the pivots, indeed, as the pivots have been reground and tested (p. 46), and owing to the plan of observing adopted (p. 50), is thought negligible. This is in contrast to the practise formerly in vogue. As for the collimation, if it may be depended upon to remain constant during a time set, it will be eliminated entirely. With instruments reversible on each star, as already noted, inequality of pivots and collimation are rigorously eliminated automatically by the reversal. Instead of depending upon the invariability of the instrumental constants for an hour, this dependence is necessary for but a few moments—a decided advantage. On the other hand, the possibility exists that too frequent reversal may disturb the azimuth; and as the disturbance is likely to occur between the two parts of each star observation, this is a serious matter. The French have accordingly introduced the practise of reading at sufficiently frequent intervals on a meridian mark.

It should be noted, too (p. 27), that among other advantages, reversal on each star leads to simplified computation.

"It is desirable, but not necessary" (pp. 43 and 80, sec. 4), is the comment on the requirement of the previous edition that the same stars, wherever possible, be observed at both stations of a longitude determination. It is now believed that errors of the star places are smaller than those introduced by the instrumental constants; or by the variation of those constants due to extending the observations over too long an interval; or by poor balancing of the A factors; or by an unwise choice of epoch for exchange of clock comparison signals (pp. 87 and 93, sec. 7). The argument upon which this reasoning is based is not conclusive; for the accidental errors of the star positions alone are taken into account, nothing being said of those classed as systematic. Yet it is probably true that great inaccuracy will not result, especially if a large proportion of the stars be observed in common at the two stations.

Not only is the publication marked by the adaptation of a new device to the old instrument, and the adoption of a new program of observing, but also by a new method of reducing the observations. The germs of this method may be found in the old edition, p. 296. The use of least squares has for the most part been done away with; the refinement, evidently, is believed to be unwarranted by the observed data. The result is a more direct and easy method of solution. To simplify the computations further, unsymmetrical threads are usually rejected (pp. 24, 79 and 80). Criteria for the rejection of other threads are laid down on p. 80. Corrections for rate (p. 24) are generally regarded as unnecessary refinement. Contrary to former practise, all stars observed at latitudes under 50° are weighted equally (pp. 79 and 80), and weights generally are taboo (p. 89).

The survey is quick to take advantage of any opportunity. When the International Geodetic Association commenced furnishing corrections for reducing the observed to the mean position of the pole, the survey began to make use of these corrections. When the *American Ephemeris and Nautical Almanac* became enabled, through the omission of the lunar distance tables, to extend its list of stars, the survey, probably having in mind also the greater ease of interpolation from the Washington meridian, assigned to that ephemeris the preference formerly held by the *Berliner Jahrbuch* (pp. 25 and 43); and from

considerations of economy it put a stop to the practise formerly permitted of computing apparent places. When, from the same cause, the *American Ephemeris* found room between its covers for tables of Polaris facilitating azimuth determinations, the survey was quick to take advantage also of these tables (p. 17).

With regard to Mr. Duvall's ingenious device for the graphical determination of the *A, B, C* factors of Mayer's formula, it may be stated that this is not the first time such a device has been put forward. Plate XII., Astronomical Observations of the U. S. Naval Observatory, Washington, 1846, with description on pp. xliv et seq., illustrates a similar solution of the same problem by Bessel's formula, the chart being adapted to the determination of $m + n \tan \delta$, and also, with the aid of an auxiliary table, of $c \sec \delta$.

The difficulty encountered in the footnote on p. 270 of the former edition has been neatly surmounted in the new.

Another novel feature is the inclusion of a treatise on time determinations with the vertical circle. It would not be surprising to find the next edition include also an account of the astrolabe. Recently developed by the French, and claimed by them to give results comparable with those obtained by the portable transit, this instrument has much to commend it. It is as portable as a theodolite, requires no firm-set pier, is easily manipulated, and the same observations employed for time may be used also for latitude.[2] On the other hand, the computations, both preliminary to and following the observations, are heavy; and the most serious obstacle encountered with this instrument, if all accounts are to be believed, would seem to be that old and familiar stumbling-block, personal equation.

From a literary standpoint the new edition is markedly improved. Where in the older volume the diction was awkward, it has here been replaced by wording more smooth and elegant. Here and there a sentence has been altered for clearness, or a phrase added to supply an idea previously left to the fruitful imagination of the reader. Where a paragraph or a sentence was superfluous, it has here been omitted. The numbering of the sections has been done away with, and more headings have been supplied for sections which properly should appear as such. It can not be said, on the other hand, that the change from words to figures when referring to numerals is a decided literary advantage; nor that all omissions have been improvements. On p. 23, for example, there might have been retained in its proper place the remark on p. 281 of the former edition, "For a discussion of this matter, see —." Among minor changes may be noted slight modifications of notation to prevent confusion, and the substitution of numerals for asterisks and daggers. The continuity is broken by continual switching from discussion of methods with the transit micrometer to those with the key, but to offset this the book is of increased value as a more complete manual.

Of the various methods for determining longitude, the ordinary telegraphic and the chronometric are treated fully. Lunar and other methods less frequently employed in the survey are merely mentioned on p. 78. Determinations by wireless telegraphy, though already employed in Europe and by the American Navy are still in the experimental stage. This will without doubt be the method of the future, and the proposed determination of the difference of longitude between the U. S. Naval Observatory and the Observatory of Paris, as well as a similar trans-Atlantic scheme under contemplation by the survey authorities for the near future, should aid greatly in the development of this method.

The publication is highly creditable to the officers of the Coast and Geodetic Survey, and the reviser and part author is to be congratulated upon maintaining so well the high standard set by his predecessors, Schott and Hayford.

David Rines

[2] See Chauvenet's "Spherical Astronomy," Vol. I., p. 280, and Claude et Driencourt's "L'Astrolabe à Prisme."

The Climate and Weather of San Diego, California. By Ford A. Carpenter, LL.D.,